CLAIMS

1. A coding apparatus comprising:

a down-sampling section that lowers a sampling rate of an input signal;

a base layer coding section that encodes an input signal of which sampling rate is lowered and obtains first coding information;

a decoding section that generates a decoded signal based on said first coding information;

an up-sampling section that raises a sampling rate of said decoded signal to a rate identical to that of said input signal;

an enhancement layer coding section that uses a parameter generated in decoding processing of said decoding section, encodes a difference value between said input signal and said decoded signal of which sampling rate is raised, and obtains second coding information; and

a multiplexing section that multiplexes said first coding information and said second coding information.

2. The coding apparatus according to claim 1, wherein said base layer coding section encodes an input signal using code excited linear prediction.

3. The coding apparatus according to claim 1, wherein said enhancement layer coding section encodes an input

signal using orthogonal transformation.

4. The coding apparatus according to claim 3, wherein said enhancement layer coding section encodes an input signal using MDCT processing.

5. The coding apparatus according to claim 1 through claim 4, wherein said enhancement layer coding section performs coding processing using the base layer LPC coefficients generated in decoding processing of said decoding section.

6. The coding apparatus according to claim 5, wherein said enhancement layer coding section converts the base layer LPC coefficients to the enhancement layer LPC coefficients based on a preset conversion table, calculates a spectral envelope based on the enhancement layer LPC coefficients, and uses said spectral envelope in at least one of spectrum normalization or vector quantization in coding processing.

7. The coding apparatus according to claim 1, wherein said enhancement layer coding section performs coding processing using a pitch period and pitch gain generated in decoding processing of said decoding section.

8. The coding apparatus according to claim 7, wherein said enhancement layer coding section calculates a

spectral fine structure using a pitch period and pitch gain, and uses said spectral fine structure in spectrum normalization and vector quantization in coding processing.

9. The coding apparatus according to claim 1, wherein said enhancement layer coding section performs coding processing using power of a decoded signal generated by said decoding section.

10. The coding apparatus according to claim 9, wherein said enhancement layer coding section quantizes a fluctuation amount of power of MDCT coefficients based on power of a decoded signal, and uses said quantized MDCT coefficient power fluctuation amount in power normalization in coding processing.

11. The sound coding apparatus according to claim 1, further comprising:

a subtraction section that obtains an error signal from a difference between an input signal at the time of input and a decoded signal of which sampling rate is raised; and

a frequency determination section that determines the frequencies subject to coding of said error signal based on a decoded signal of which sampling rate is raised;

wherein said enhancement layer coding section encodes said error signal at said frequencies.

12. The sound coding apparatus according to claim 11, further comprising an auditory masking section that calculates auditory masking that indicates an amplitude value that does not contribute to hearing;

wherein said enhancement layer coding section determines an object of coding so that a signal within said auditory masking is not made an object of coding in said frequency determination section and encodes an error spectrum that is a spectrum of said error signal.

13. The sound coding apparatus according to claim 12, wherein:

said auditory masking section comprises:

a frequency domain transformation section that transforms a decoded signal of which sampling rate is raised to frequency domaincoefficients;

an estimated auditory masking calculation section that calculates estimated auditory masking using said frequency domain coefficients; and

a determination section that finds a frequency at which an amplitude value of a spectrum of said decoded signal exceeds an amplitude value of said estimated auditory masking;

and said enhancement layer coding section encodes said error spectrum located at said frequency.

14. The sound coding apparatus according to claim 13,

wherein:

said auditory masking section comprises an estimated error spectrum calculation section that calculates an estimated error spectrum using said frequency domain coefficients; and

said determination section finds the frequencies at which an amplitude value of said estimated error spectrum exceeds an amplitude value of said estimated auditory masking.

15. The sound coding apparatus according to claim 13, wherein:

said auditory masking section comprises a correction section that smoothes estimated auditory masking calculated by said estimated auditory masking calculation section; and

said determination section finds the frequencies at which an amplitude value of said decoded signal spectrum or said estimated error spectrum exceeds an amplitude value of smoothed said estimated auditory masking.

16. The sound coding apparatus according to claim 13, wherein said enhancement layer coding section calculates for each frequency an amplitude value difference between either an estimated error spectrum or error spectrum and either auditory masking or estimated auditory masking, and determines an amount of coding information based on the amount of said amplitude value difference.

17. The sound coding apparatus according to claim 13, wherein said enhancement layer coding section encodes said error spectrum in a predetermined band in addition to the frequencies found by said determination section.

18. A decoding apparatus comprising:

a base layer decoding section that decodes first coding information in which an input signal is coded in predetermined base frame units by a coding side and obtains a first decoded signal;

an enhancement layer decoding section that decodes second coding information and obtains a second decoded signal;

an up-sampling section that raises a sampling rate of said first decoded signal to a rate identical to that of said second decoded signal; and

an addition section that adds said first decoded signal of which sampling rate is raised and said second decoded signal.

19. The decoding apparatus according to claim 18, wherein said base layer decoding section decodes first coding information generated by code excited linear prediction.

20. The decoding apparatus according to claim 18, wherein said enhancement layer decoding section decodes

second coding information using orthogonal transformation.

21. The decoding apparatus according to claim 20, wherein said enhancement layer decoding section decodes second coding information using inverse MDCT processing.

22. The decoding apparatus according to claim 18, wherein said enhancement layer decoding section decodes second coding information using the base layer LPC coefficients.

23. The decoding apparatus according to claim 22, wherein said enhancement layer decoding section converts the base layer LPC coefficients to the enhancement layer LPC coefficients based on a preset conversion table, calculates a spectral envelope based on the enhancement layer LPC coefficients, and uses said spectral envelope in vector decoding in decoding processing.

24. The decoding apparatus according to claim 18, wherein said enhancement layer decoding section performs decoding processing using at least one of pitch period or pitch gain.

25. The decoding apparatus according to claim 24, wherein said enhancement layer decoding section calculates a spectral fine structure using a pitch period

and pitch gain, and uses said spectral fine structure in vector decoding in decoding processing.

26. The decoding apparatus according to claim 24, wherein said enhancement layer decoding section performs decoding processing using power of a decoded signal generated by said decoding section.

27. The decoding apparatus according to claim 26, wherein said enhancement layer decoding section decodes a fluctuation amount of power of MDCT coefficients based on power of a decoded signal, and uses said decoded MDCT coefficients power fluctuation amount in power normalization in decoding processing.

28. The sound decoding apparatus according to claim 18, further comprising a frequency determination section that determines the frequencies subject to decoding of second coding information in which a residual error signal of an input signal and a signal resulting from decoding of first coding information is coded by a coding side based on said up-sampled first decoded signal; wherein:

said enhancement layer decoding section decodes said second coding information using said frequency information and generates a second decoded signal; and

said addition section adds said second decoded signal and a first decoded signal of which sampling rate is raised.

29. The sound decoding apparatus according to claim 28, further comprising an auditory masking section that calculates auditory masking that indicates an amplitude value that does not contribute to hearing;

wherein said enhancement layer decoding section determines an object of decoding so that a signal within said auditory masking is not made an object of decoding in said frequency determination section.

30. The sound decoding apparatus according to claim 29, wherein:

said auditory masking section comprises:

a frequency domain transformation section that transforms a base layer decoded signal of which sampling rate is raised to frequency domain coefficients;

an estimated auditory masking calculation section that calculates estimated auditory masking using said frequency domain coefficients; and

a determination section that finds the frequencies at which an amplitude value of a spectrum of said decoded signal exceeds an amplitude value of said estimated auditory masking;

and said enhancement layer decoding section decodes said error spectrum located at said frequencies.

31. The sound decoding apparatus according to claim 30, wherein:

said auditory masking section comprises an estimated error spectrum calculation section that calculates an estimated error spectrum using said frequency domain coefficients; and

said determination section finds the frequencies at which an amplitude value of said estimated error spectrum exceeds an amplitude value of said estimated auditory masking.

32. The sound decoding apparatus according to claim 30, wherein:

said auditory masking section comprises a correction section that smoothes estimated auditory masking calculated by said estimated auditory masking calculation section; and

said determination section finds the frequencies at which an amplitude value of said decoded signal spectrum or said estimated error spectrum exceeds an amplitude value of smoothed said estimated auditory masking.

33. The sound decoding apparatus according to claim 29, wherein said enhancement layer decoding section calculates for each frequency an amplitude value difference between either an estimated error spectrum or error spectrum and either auditory masking or estimated auditory masking, and determines an amount of decoding information based on the amount of said amplitude value difference.

34. The sound decoding apparatus according to claim 29, wherein said enhancement layer decoding section decodes said error spectrum in a predetermined band in addition to the frequencies found by said determination section.

35. An acoustic signal transmitting apparatus comprising:

an acoustic input section that converts an acoustic signal to an electrical signal;

an A/D conversion section that converts a signal output from said acoustic input section to a digital signal;

the coding apparatus according to claim 1 that encodes a digital signal output from said A/D conversion section;

an RF modulation section that modulates coding information output from said coding apparatus to a radio frequency signal; and

a transmitting antenna that converts a signal output from said RF modulation section to a radio wave, and transmits that radio wave.

36. An acoustic signal receiving apparatus comprising:

a receiving antenna that receives a radio wave;

an RF demodulation section that demodulates a signal received by said receiving antenna;

the decoding apparatus according to claim 18 that

decodes information obtained by said RF demodulation section;

a D/A conversion section that converts a signal output from said decoding apparatus to an analog signal; and

an acoustic output section that converts an electrical signal output from said D/A conversion section to an acoustic signal.

37. A communication terminal apparatus comprising the acoustic signal transmitting apparatus according to claim 35.

38. A communication terminal apparatus comprising the acoustic signal receiving apparatus according to claim 36.

39. A base station apparatus comprising the acoustic signal transmitting apparatus according to claim 35.

40. A base station apparatus comprising the acoustic signal receiving apparatus according to claim 36.

41. A coding method comprising:

a step of lowering a sampling rate of an input signal;

a step of coding an input signal of which sampling rate is lowered and obtaining first coding information;

a step of generating a decoded signal based on said

first coding information;

a step of raising a sampling rate of said decoded signal to a rate identical to that of said input signal;

a step of using a parameter obtained in processing that generates said decoded signal, coding a difference value between said input signal and said decoded signal of which sampling rate is raised, and obtaining second coding information; and

a step of multiplexing said first coding information and said second coding information.

42. A decoding method comprising:

a step of decoding first coding information and obtaining a first decoded signal;

a step of decoding second coding information and obtaining a second decoded signal;

a step of raising a sampling rate of said first decoded signal to a rate identical to that of said second decoded signal; and

a step of adding said first signal of which sampling rate is raised and said second signal.